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## Abstract

### Design for Measurements of Environmental Radon Using TLDs

**by**
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Lawrence Livermore National Laboratory (LLNL) has measured and reported gamma radiation at the Livermore Site perimeter since 1973. Gamma radiation results from natural background sources of geologic/terrestrial or cosmic origin, or from man-made sources, such as fallout from past nuclear weapon testing, and contribution from LLNL operations.

Direct radiation and air particulate data routinely collected over the past twenty years at LLNL with thermoluminescent dosimeters (TLDs) and high volume air monitors show elevated levels during the fall quarter of each year.

We hypothesize that seasonal variation in direct radiation measurements using TLDs, and beta activity reflects radon concentrations caused by seasonal meteorological and related geological conditions. A test of this hypothesis can be conducted by measuring radon directly with a device that shields out all gamma radiation except for gamma emission from radon daughter products. The shield consists of a two inch lead cave which will hold a measuring detector. The concentration levels, the direct radiation measurement, and barometric pressure will be analyzed for correlation with the routine analyses and experimental analyses.

A radon measuring head is designed to hold two TLD chips with an aluminum shield between them. In the front of the TLDs a filter holder is designed to hold a millipore filter approximately 6 mm. An opening is at the end of the measuring head below the filter to draw ambiant air across the filter where particulates will be collected. The decay from radon daughters will yield the gamma radiation measured from the radon on the TLD chips. The apparatus is connected to a rotometer and a electrical motor so that the air flow is accurately measured. The measuring head will sit inside a lead cave so that all other gamma activity is shielded to a minimum. Another TLD chip will be placed outside of the measuring head but inside the lead cave in order to measure cosmic radiation. The difference between the two should be the actual radon measured with the radon measuring head.

The detector consists of two modules: 1) suction equipment to continuously pass the air that is being sampled through a collection filter; and equipment to keep the air flow constant; and 2) a measuring head with the filter to collect the radon daughter products contained in the air flow. Calcium fluoride (CaF) TLD chips are used in the measuring head for measurements because they are readily available for use. However, since these TLDs are known to have 30 percent fading, a correction factor will be used to fade-correct the data. The TLD that is opposite the filter will detect beta radiation, and that TLD furthest away from the filter will measure gamma radiation. The thin layer of aluminum will be inserted between the two TLD chips to prevent the beta from reaching the TLD chip for gamma. The filter in this detector will be analyzed for beta activity and a gamma spectrum analysis will be run to correlate the activity with routine beta analysis to determine the contribution from seasonal radon (if any).

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